IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	H. Grant Wang et al.
Serial No.:	10/727,764
Filed:	December 3, 2003
Title:	UNIFIED SENSOR-BASED ATTITUDE DETERMINATION AND CONTROL FOR SPACECRAFT OPERATIONS
Examiner:	Stephen A Holzen
Art Unit:	3644

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EXPEDITED PROCESSING REQUESTED
Response Under 37 CFR §1.116
Examining Group No. 3644

RESPONSE TO OFFICE ACTION

Dear Sir:

In the Office Action of March 8, 2007, the Examiner noted that claims 1, 2, 4, 5, 17, 21, 23, 24, 27, 35, and 36 are pending in the application and rejected claims 1, 2, 4, 5, 17, 21, 23, 24, 27, 35, and 36 under 35 USC §103(a). Applicant responds to the Examiner's rejections below.

Claim Rejections – 35 USC §103(a)

The Examiner rejected claims 1, 2, 4, 5, 21, 27, 35, and 36 under 35 USC §103(a) as being unpatentable over Hosick (US Patent No. 6,032,904) in view of van Bezooijen (US Patent No. 5,745,869). Applicant respectfully submits that claims 1, 2, 4, 5, 21, 27, 35, and 36 are patentable over Hosick in view of van Bezooijen.

As for independent claim 1, neither Hosick nor van Bezooijen discuss or suggest "software that determines the attitude of the spacecraft during both transfer orbit operations and

on-station operations based solely on the input received from one of the plurality of sensors" as recited in claim 1.

In Hosick, an entire sensor suite (32), which contains earth sensors, a set of gyroscopes, and possibly several sun sensors and/or a star tracker (see col. 6, ll. 59-65), is used to determine spacecraft attitude and orientation (see col. 6, ll. 56-59). Nowhere does Hosick discuss or suggest that the attitude of the spacecraft is or can be determined based on the input received from only one of the sensors in the sensor suite. In fact, in the Office Action the Examiner acknowledges that, "Hosick does not teach the capability of being able to determine attitude from a single sensor input."

In addition, van Bezooijen does not discuss or suggest the use of single sensor to determine spacecraft attitude during transfer orbit operations. van Bezooijen only teaches the use of an autonomous star tracker (AST) during on-station operations (see e.g. col. 4, ll. 36-40 "After a slew to a new target, AST 10, operating in update mode, identifies the stars 2 in its field of view 20, determines its attitude…"). Nowhere does van Bezooijen discuss or suggest using the AST to determine spacecraft attitude during both transfer orbit operations and on-station operations.

Therefore, even if such a combination as Hosick and van Bezooijen were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claim 1. Claims 2, 4, 5, and 21 depend from independent claim 1 and for the reasons stated above are also patentable over Hosick in view of van Bezooijen.

Applicant also traverses the Examiner's statement that "functional language in the claims does not serve to impart patentability" and "therefore that the star sensors are inherently capable of being the sole source attitude sensor date [sic]."

Applicant respectfully submits that the independent claims do not recite a manner in which an attitude determination and control system is used, but rather recite a novel and non-obvious structure for an attitude determination and control system. Sensors, such as earth sensors, sun sensors, star trackers, etc. provide data regarding the position of objects in relation to the sensor to a processor. However, these sensors are merely data providers and do not determine the attitude of the spacecraft. It is the type of software that resides on the processor that determines the attitude of the spacecraft based on the data received from the sensors. For example the software could be programmed to determine attitude from data received from multiple sensors or from a single sensor regardless of how many sensors are used; the software could be programmed to determine attitude only during on-stations operations or during transfer orbit operations or during both; or the software could be programmed with any combination such as determining attitude using multiple sensors during transfer orbit operations and determining attitude using a single sensor during on-station operations. It is the structural difference of the type of software used that makes the attitude and control systems different.

In the independent claims, the language used describes the type of software that is used in the claimed attitude determination and control system, not how the claimed attitude determination and control system will be used. As the term "software" is a generic term, this language is analogous to reciting a specific type of software such as "word-processing software." Stating the specific type of software is the same as stating that a "phillips head, right hand threaded, ¼ screw" is used rather than stating merely a generic "screw." The specific type of software, e.g. software that determines attitude during both transfer orbit operations and on-station operations based solely on the input received from one sensor, is a structural recitation that provides a structural difference between attitude determination and control systems. As

acknowledged by the Examiner, "Inherently any controller has…"software". Controllers are programmable electrical devices." However, the type of software used determines what type of controller it is. A controller having automobile transmission control software is structurally different that a controller having spacecraft attitude determination software. One cannot be used in the place of the other. Therefore, Applicant respectfully submits that the recitation of a specific type of software residing on the processor in independent claims 1, 27, 35, and 36 does provide a structural recitation that does differentiate the claimed apparatus from prior art apparatus and does not merely recited a manner of using the claimed attitude determination and control system.

As for independent claim 27, neither Hosick nor van Bezooijen discuss or suggest "software that determines the attitude of the spacecraft during both transfer orbit operations and on-station operations based solely on the input received from one of the star trackers" as recited in claim 27. As discussed above, Hosick does not discuss or suggest determining the attitude of a spacecraft based on the input from a single sensor, much less a single star tracker, and van Bezooijen does not discuss or suggest using the AST to determine the attitude of a spacecraft during transfer orbit operations. Therefore, even if such a combination as Hosick and van Bezooijen were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claim 27.

As for independent claim 35, neither Hosick nor van Bezooijen discuss or suggest an "attitude sensor set consisting of at least one star tracker" and "software used for both transfer orbit and on-station attitude determination using solely the input from the attitude sensor set" as recited in claim 35. As discussed above, Hosick teaches the use of an entire sensor suite to determine spacecraft attitude and does not discuss or suggest the use of only star trackers to

determine spacecraft attitude during any operations. In addition, van Bezooijen does not discuss or suggest using the AST to determine the attitude of a spacecraft during transfer orbit operations. Therefore, even if such a combination as Hosick and van Bezooijen were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claim 35.

As for independent claim 36, neither Hosick nor van Bezooijen discuss or suggest an "attitude sensor set consisting of at least one star tracker and at least one gyro device" and "software used for both transfer orbit and on-station attitude determination using solely the input from the attitude sensor set" as recited in claim 36. As discussed above, Hosick teaches the use on an entire sensor suite including earth sensors and gyroscopes, and possibly also sun sensors and star trackers in addition to the earth sensors and gryroscopes, to determine the attitude of the spacecraft. However, Hosick does not discuss or suggest the use of only star trackers and gyroscopes to determine the attitude of the space craft. In addition, van Bezooijen only teaches the use of a single AST to determine the attitude of the spacecraft during on-station operations and does not discuss or suggest the use of gyro devices at all or the use of any sensors during transfer orbit operations. Therefore, even if such a combination as Hosick and van Bezooijen were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claim 36.

In addition to the recited elements missing from both Hosick and van Bezooijen, Applicant respectfully submits that it would not have been obvious to one with skill in the relevant art to combine Hosick and van Bezooijen, as van Bezooijen teaches away from Hosick.

In Hosick, spacecraft attitude is determined through the use of an entire suite of sensors such as earth sensors and gyroscopes, and possibly also sun sensors and star trackers (see col. 6,

ll. 56-65). Conversely, van Bezooijen teaches that the use of combinations of sun sensors, earth sensors, star trackers, etc. is too complex and time consuming and states that the AST taught in van Bezooijen can be used by itself to replace all of these sensors (see col. 4, ll. 1-9). Therefore, one skilled in the art would not combine the multiple sensors of Hosick with the AST of van Bezooijen as van Bezooijen teaches away from the use of multiple sensors and teaches that only the AST should be used in place of multiple sensors.

The Examiner also rejected claim 17 under 35 USC §103(a) as being unpatentable over Hosick in view of the Boeing 702 fleet. Applicant respectfully submits that claim 17 is patentable over Hosick in view of the Boeing 702 fleet.

Claim 17 depends from independent claim 1. As discussed above for independent claim 1, Hosick does not discuss or suggest "software that determines the attitude of the spacecraft during both transfer orbit operations and on-station operations based solely on the input received from one of the plurality of sensors" (emphasis added) as recited in independent claim 1. In addition, the Boeing 702 fleet does not discuss or suggest "software that determines the attitude of the spacecraft during both transfer orbit operations and on-station operations based solely on the input received from one of the plurality of sensors". Therefore, even if such a combination as Hosick and the Boeing 702 fleet were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claim 17.

The Examiner also rejected claims 23 and 24 under 35 USC §103(a) as being unpatentable over Hosick in view of Baghdasarian (US Patent No. 6,010,096). Applicant respectfully submits that claims 23 and 24 are patentable over Hosick in view of Baghdasarian.

Claims 23 and 24 depend from independent claim 1. As discussed above for independent claim 1, Hosick does not discuss or suggest "software that determines the attitude of the

spacecraft during both transfer orbit operations and on-station operations based solely on the input received from one of the plurality of sensors" (emphasis added) as recited in independent claim 1. In addition, Baghdasarian does not discuss or suggest "software that determines the attitude of the spacecraft during both transfer orbit operations and on-station operations based solely on the input received from one of the plurality of sensors". Therefore, even if such a combination as Hosick and Baghdasarian were made, which Applicant does not concede is proper, the purported combination still would not reflect all of the elements recited in claims 23 and 24.

Conclusion

In view of the aforesaid, Applicant respectfully submits that claims 1, 2, 4, 5, 17, 21, 23, 24, 27, 35, and 36 are in condition for allowance and a Notice of Allowance for these claims is respectfully requested.

Respectfully submitted,

Dated: May 7, 2007

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